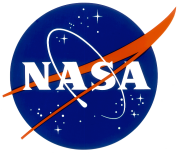# Calibration Status of the
Atmospheric Infrared Sounder (AIRS) on Aqua
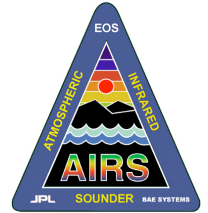
Steve Gaiser

Jet Propulsion Laboratory,
California Institute of Technology
4800 Oak Grove Avenue, Pasadena, CA 91109

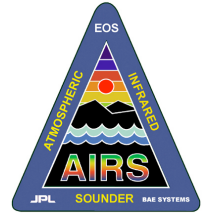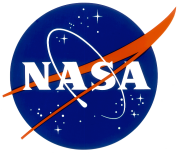# AGENDA
AIRS Calibration Status

- **Radiometric status**

- **Spectral Status**

- **Spatial Status**

- **Vis/NIR Status**

- **Summary**

Based on 2-point in-orbit calibration, with corrections for polarization and non-linearity (each < ~1.5%)

$$N_{sc,i,j} = \frac{a_o(\theta_j) + a_{1,i}(dn_{i,j} - dn_{sv,i}) + a_2(dn_{i,j} - dn_{sv,i})^2}{1 + p_r p_t \cos 2(\theta_j - \delta)}$$

$$a_o(\theta_j) = P_{sm} p_r p_t [\cos 2(\theta_j - \delta) + \cos 2\delta]$$

$$a_{1,i} = \frac{N_{OBC,i}(1 + p_r p_t \cos 2\delta) - a_o(\theta_{OBC}) - a_2(dn_{obc,i} - dn_{sv,i})^2}{(dn_{obc,i} - dn_{sv,i})}$$

$N_{sc,i,j}$ = Scene Radiance (mW/m²-sr-cm⁻¹)
Psm = Plank radiation function
$N_{OBC,i}$ = Radiance of the On-Board Calibrator
i = Scan Index, j = Footprint Index
q = Scan Angle. q = 0 is nadir.
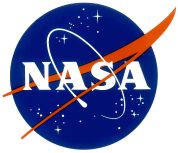
$dn_{i,j}$ = Raw Digital Number in the Earth View
$dn_{sv,i}$ = Space view counts offset.
a_o = Radiometric offset. $a_{1,i}$ = Radiometric gain.
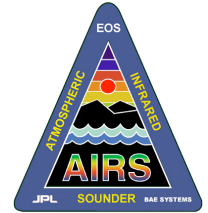a_2 = Nonlinearity
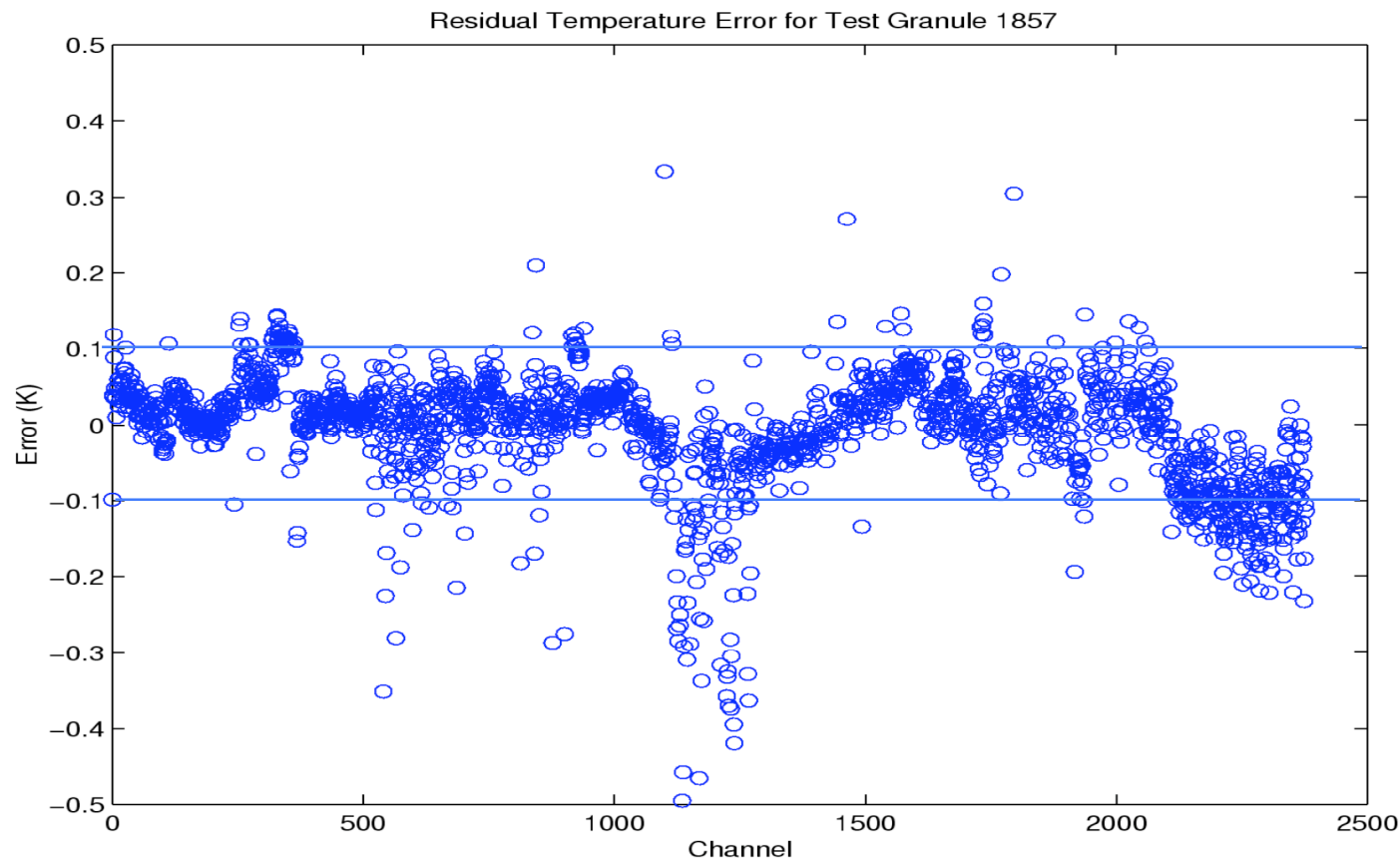$p_r p_t$ = Polarization Factor Product
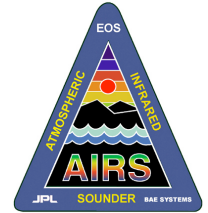d = Phase of the polarization

Simple radiometric transfer equations lead to exceptional accuracy: Pre-flight residuals < +/- 0.1K for >90% of channels

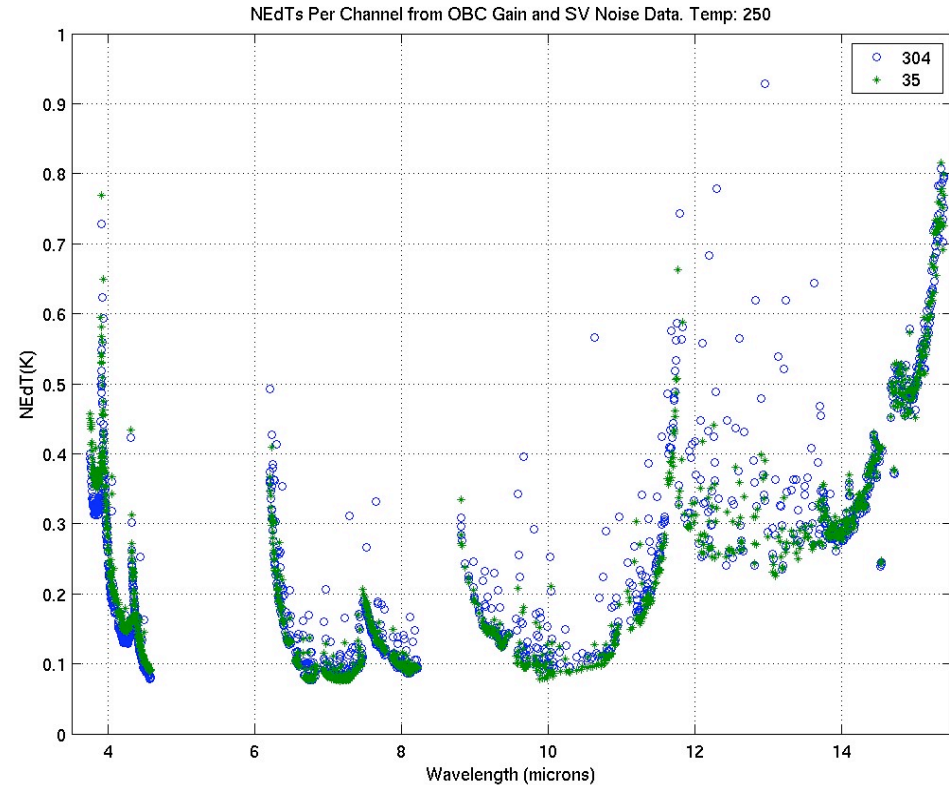Residual Temperature Error for Test Granule 1857

- **In-orbit special test data analyzed**

- **Consistent w/ pre-flight measurements**

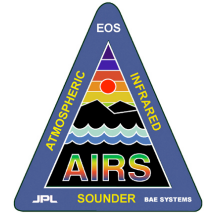- **Calculated for a 250K scene**

- **AIRS NEDTs look good in orbit**

NEdTs Per Channel from OBC Gain and SV Noise Data. Temp: 250

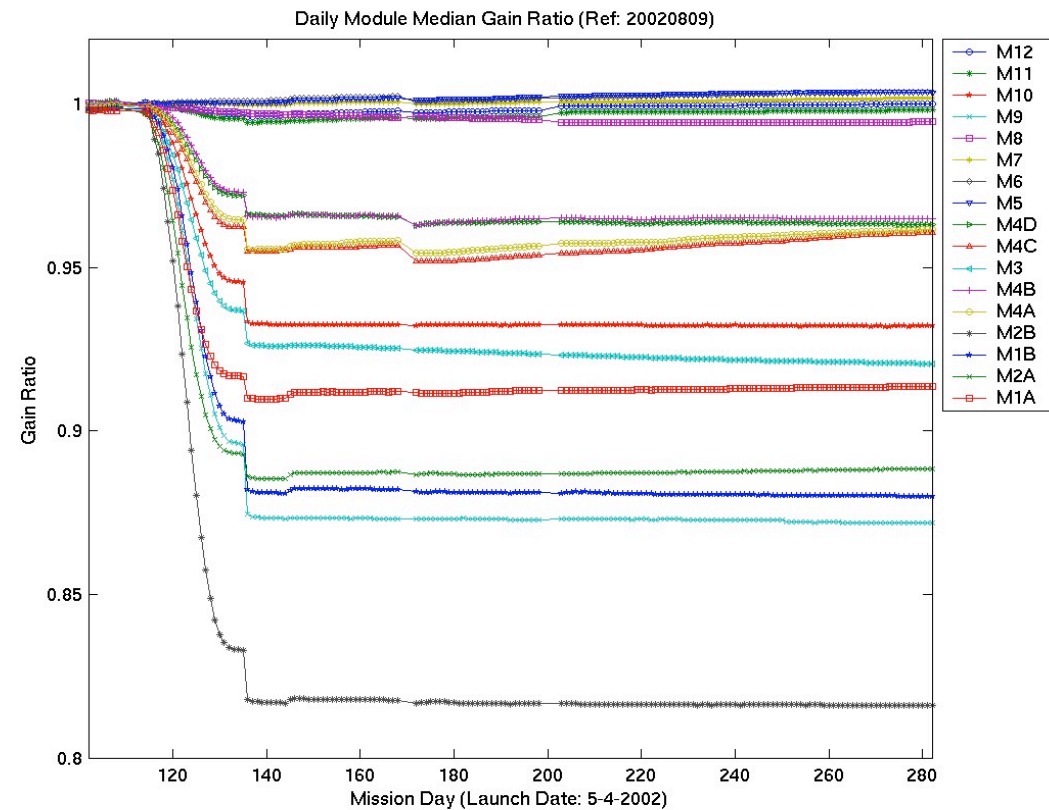$$NEN_{scene} = Gain \times \sqrt{\left(N_{scene} \Big/ N_{obc} \right) \left(DN_{obc}{}^2 - DN_{sv}{}^2 \right) + DN_{sv}{}^2}$$

RADIOMETRIC STABILITY
AIRS Calibration Status

- Icing observed early in mission

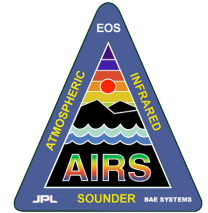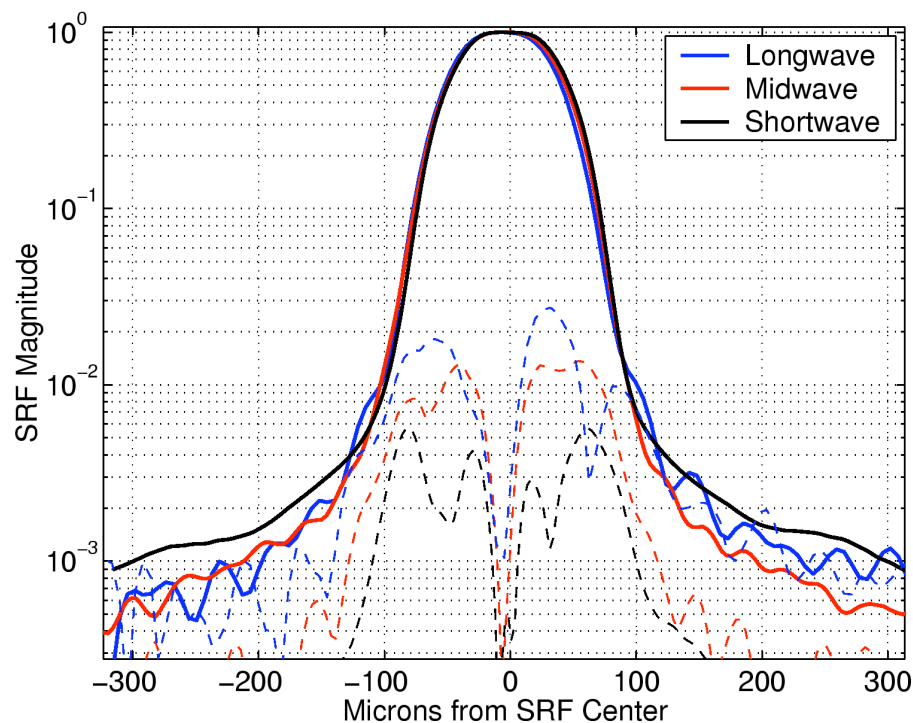- Detector responsivities are now stable (< 0.3% change/month)

Daily Module Median Gain Ratio (Ref: 20020809)

Gain Ratio

Mission Day (Launch Date: 5-4-2002)

21-Feb-2003 14:29:36

Legend: M12, M11, M10, M9, M8, M7, M6, M5, M4D, M4C, M3, M4B, M4A, M2B, M1B, M2A, M1A
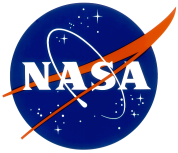
SPECTRAL CHARACTERIZATION
AIRS Calibration Status

AIRS Science Team Meeting, Feb. 25-27, 2003, Camp Springs, MD
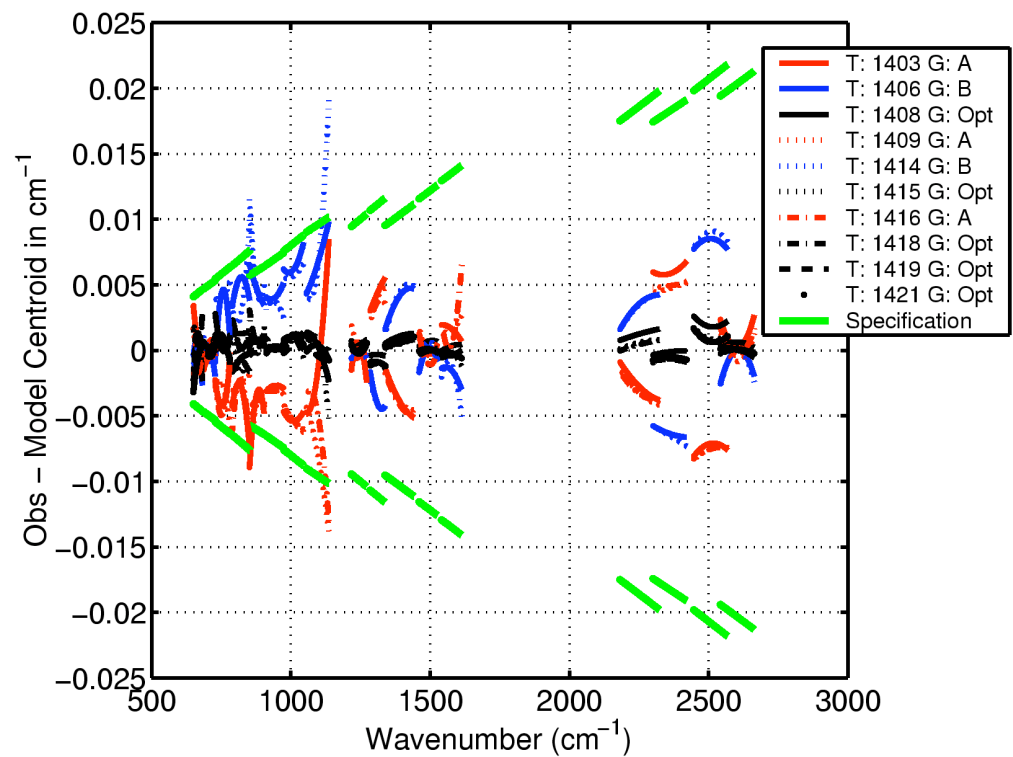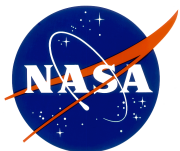
SPECTRAL STABILITY
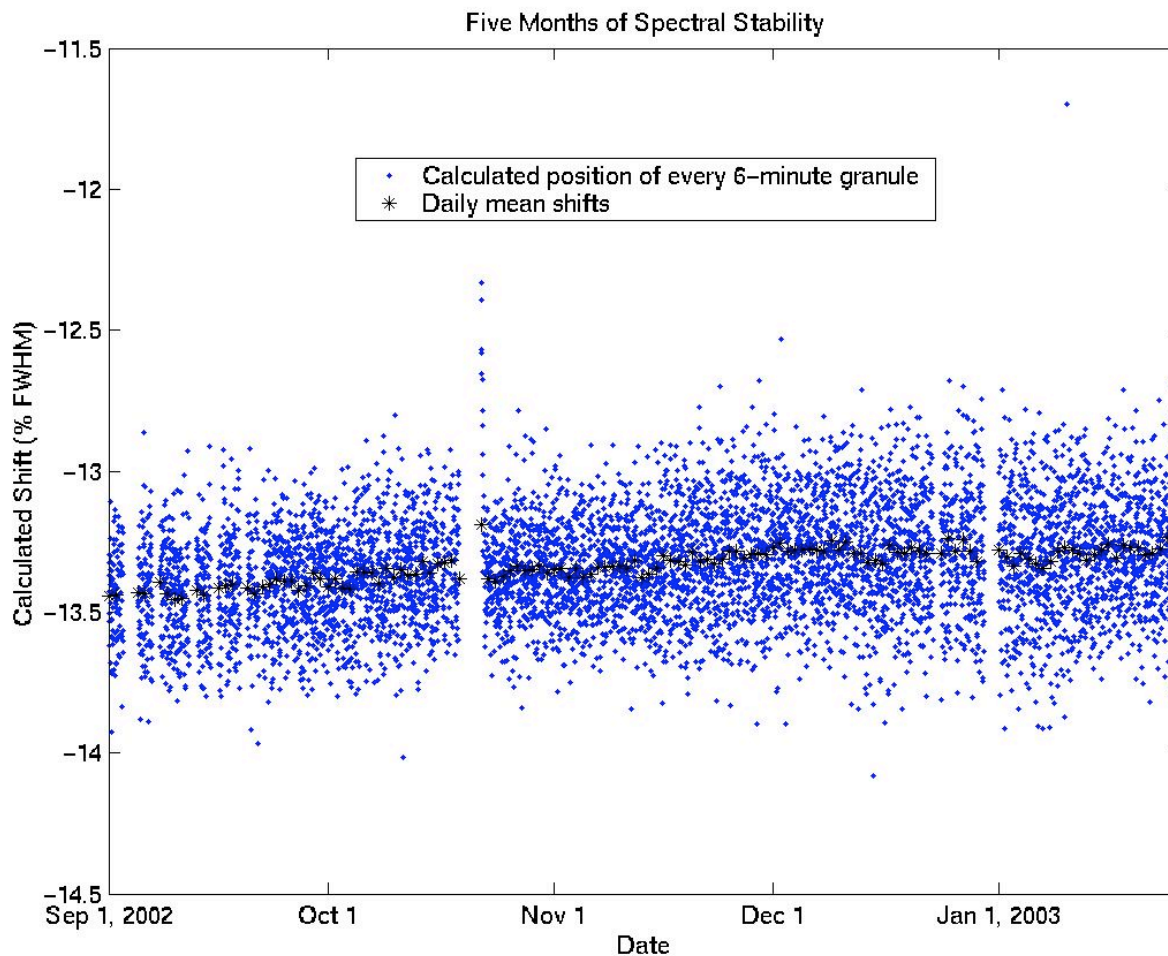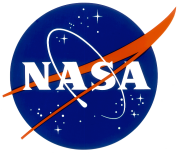## AIRS Calibration Status
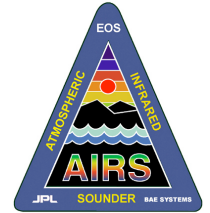
- **The AIRS spectrometer has a 23-hour thermal time constant, measured pre-flight**

- **In-orbit spectral calibration provides the most sensitive measurement of instrument stability**

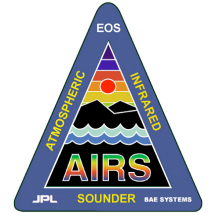- **AIRS is extremely stable spectrally: < 0.03%/month shift**
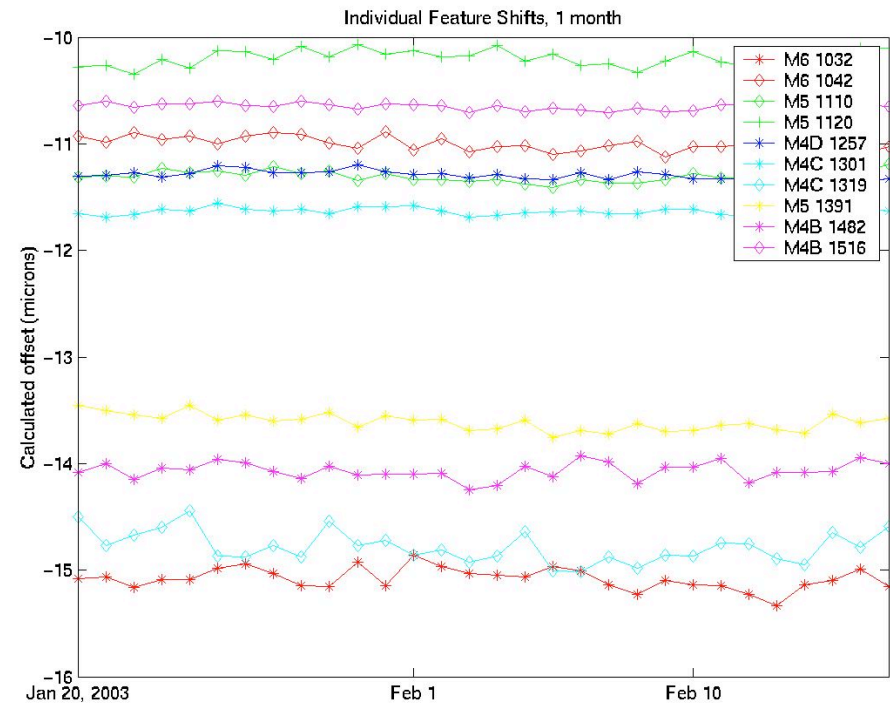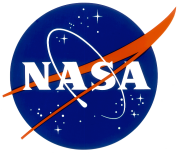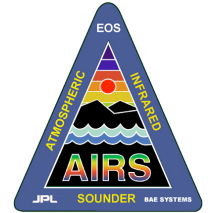
Five Months of Spectral Stability

- **SRF centroids known to 0.5% FWHM based on the pre-flight model**

- **Validated to ~1.5% in all bands except M5**

- **Stability not in question for M5**

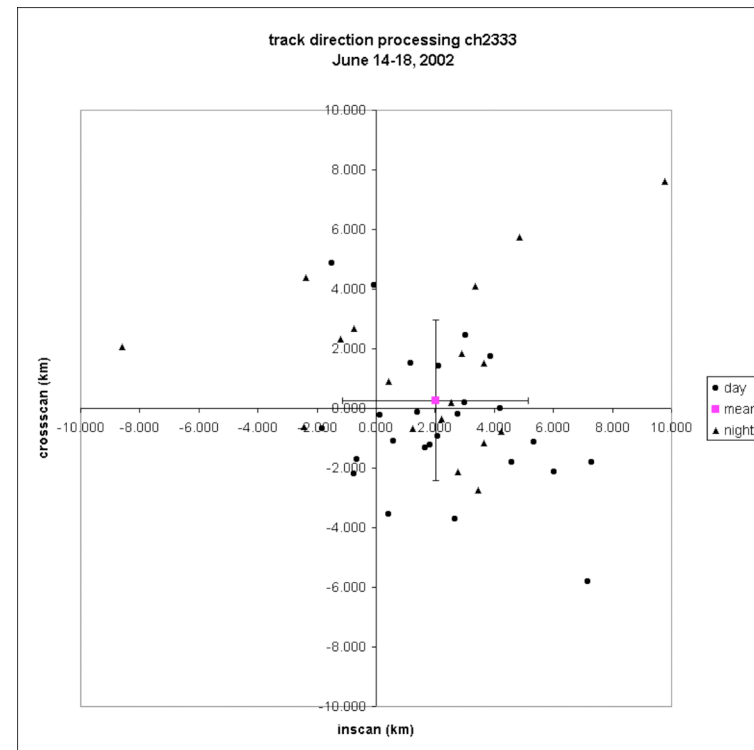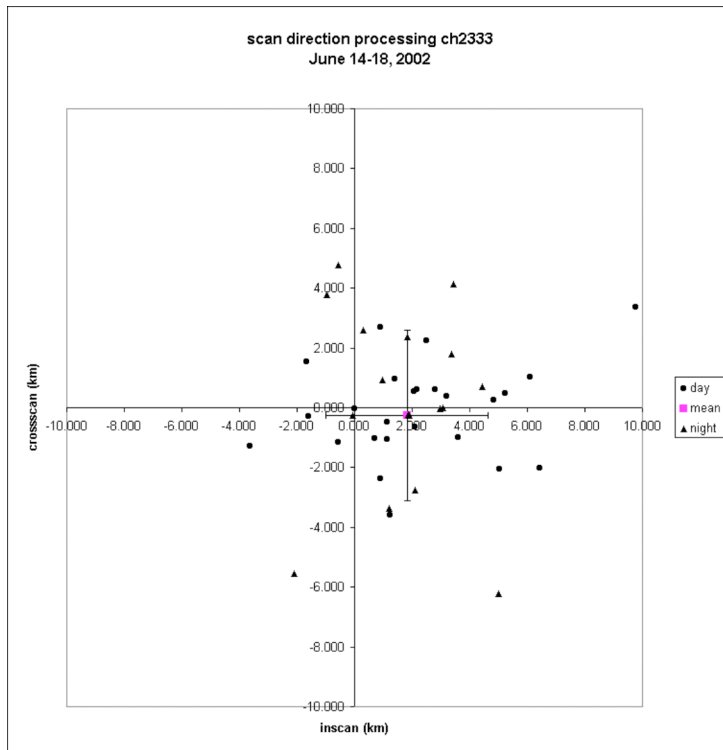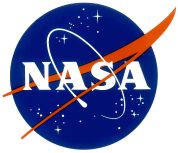Individual Feature Shifts, 1 month
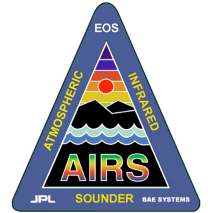
GEOLOCATION ACCURACY
AIRS Calibration Status

- **Done by Dave Gregorich, based on MODIS approach**

- **Method is described in TGRS special issue**

- **Finds apparent shift of 2 km in cross-track direction**

L1B and L2 products are in good shape, no significant liens.
Current activities:

- Coregistration. An area-matching technique (comparing cloud patterns in ocean granules) is being used to assess the relative alignment of IR and Vis in instrument coordinates (line/sample).
- Geolocation. Similar area matching techniques will be applied in an earth-based coordinate system (lon/lat), allowing comparisons to AMSU, HSB, MODIS, MISR, and USGS data sets. This follows up on work reported previously by UCSB.
- Additional validation of cloud flags. UCSB reported excellent agreement between MODIS and AIRS-Vis/NIR cloud flags. Will now compare Vis/NIR to lidar results.
- Vis/NIR global surface maps. Refine data selection and smoothing criteria when generating global maps of surface-type. These maps are currently used in cloud detection, and to provide NDVI information in L1b files.
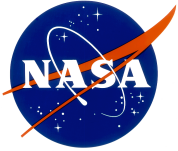
SUMMARY
AIRS Calibration Status
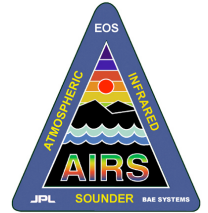
- **AIRS IR radiometric accuracy and precision are outstanding**

- **AIRS spectral stability is excellent**

- **Geolocation information is currently good to 1/5th an IFOV**

- **VIS/NIR is performing as expected**